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MODEL 543 OMEGA GATING UNIT AND MODEL 599-700R LOOP ANTENNA

12113

Tracor, Inc.

OPERATION AND
SERVICE MANUAL

MODEL 543
OMEGA GATING UNIT
AND MODEL 599-700R
LOOP ANTENNA

NEED STOCK # FOR
COMPLEAT UNIT.

12113

Tracor, Inc.

WARRANTY

1. Tracor, Inc., "Seller", warrants the goods sold will conform with all pertinent specifications including performance specifications, drawings and approved samples, as furnished.

2. Seller also warrants said goods to be free of defective materials and workmanship.

3. This warranty is in lieu of all other warranties, express or implied. SELLER MAKES NO WARRANTY THAT SAID GOODS ARE FIT FOR ANY PARTICULAR PURPOSE, NOR ANY WARRANTY AS TO THE MERCHANTABILITY OR QUALITY OF GOODS SOLD EXCEPT AS HEREIN STATED.

4. All claims for alleged defects of goods under this warranty shall be deemed waived unless made in writing and delivered to Seller within twelve (12) months after date of shipment, unless otherwise specified hereinbelow, and on any such claims, Seller has the option of inspecting the goods claimed defective at the Buyer's place of business or having them re-shipped to Seller for inspection.

5. Instrument parts which have been repaired or replaced during the warranty period are themselves warranted only for the remaining unexpired portion of the original one (1) year warranty.

6. This warranty shall not apply where goods have been subject to misuse, neglect, accident or improper application or have been repaired or substantially altered by others, nor does this warranty apply to items consumed in the ordinary course of use of the goods, such as, but not limited to, fuses or batteries.

7. Transportation charges covering returned goods will be borne by Buyer, unless such goods are determined by Seller to be defective and covered by the warranty. No returns will be accepted unless authorized by Seller.

8. SELLER'S LIABILITY SHALL BE LIMITED TO SELLER'S STATED SELLING PRICE PER UNIT OF ANY DEFECTIVE GOODS AND SHALL IN NO EVENT INCLUDE BUYER'S MANUFACTURING COST, LOST PROFITS, GOOD WILL OR ANY OTHER SPECIAL OR CONSEQUENTIAL DAMAGES. Seller may, at its discretion, replace, or giver Buyer credit for, such defective items.

9. Tracor, Inc., warrants each Rubidium Gas Cell, utilized in its Rubidium Frequency Standards and Clocks, for five (5) years after date of delivery to the original purchaser.

10. This warranty shall be governed by the laws of Texas.

Tracor Instruments

Industrial Division

Tracor, Inc. 6500 Tracor Lane Austin, Texas 78721 Telephone 512:926 2800

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SECTION I

GENERAL DESCRIPTION

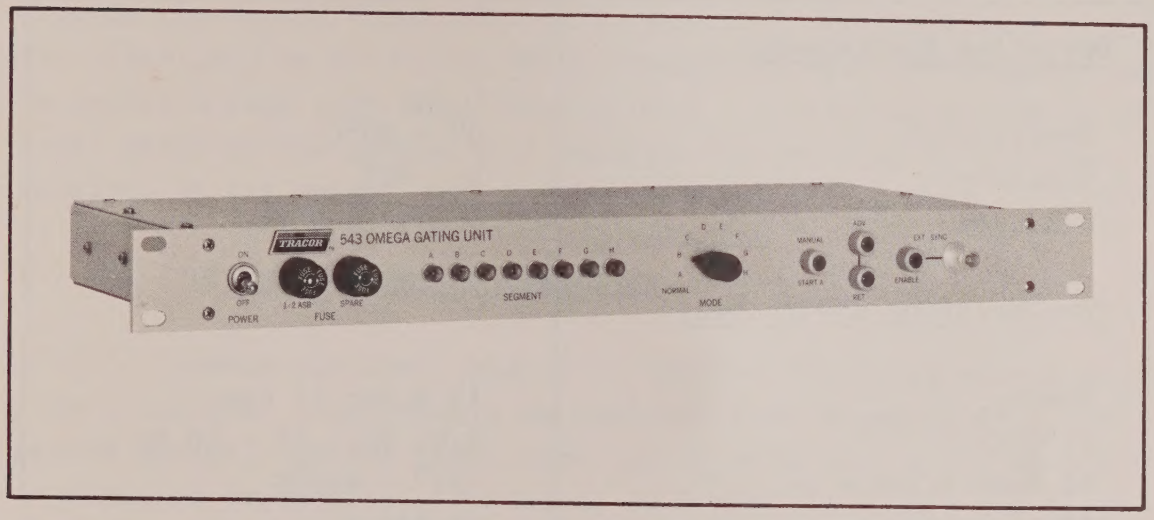

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Figure 1-1. Model 543 OMEGA Gating Unit

1-1. INTRODUCTION.

1-2. This section describes the TRACOR, Inc., Model 543 OMEGA Gating Unit. The description includes the main features, general theory of operation, capabilities, function and purpose.

1-3. DESCRIPTION.

1-4. The Model 543 OMEGA Gating Unit (Figure 1-1) is fully contained within one single equipment. An adapter cable is furnished for interfacing the Model 543 with the TRACOR Model 599J or K, modified VLF Receivers. Leading particulars are shown in table 1-1.

Table 1-1. OMEGA Gating Unit Leading Particulars

ITEM	PARTICULARS
Operating Environment	
Temperature	0° - 60°C
Humidity	0 - 90%
Altitude	0 - 10,000 ft.
Non-Operating Environment	
Shock	15 g for 11 msec
Vibration	0.01 in., 10 - 50 Hz
48 hour storage at	-55° - +60°C
12 hour storage at	40,000 ft.
Power Requirements	-10 V at 300 mA
Weight	5 lbs.
Dimensions	
Height	1.75 in.
Width	19 in. (standard panel mounting)
Depth	9 in.

1-5. PURPOSE.

1-6. The TRACOR Model 543 OMEGA Gating Unit was developed to provide the TRACOR Model 599J or K, modified, VLF Receivers with the capability of utilizing OMEGA transmissions. One receiver may be operated from each OMEGA Gating Unit. A selector switch on the front panel of the gating unit permits the operator to use the receiver in its normal function or with the gating unit.

1-7. GENERAL THEORY OF OPERATION.

1-8. OMEGA stations, placed at various locations around the globe, transmit repetitively on assigned time segments of a ten second period. At any given time one or more stations transmit on assigned frequencies, including 10.2 kHz, 13.6 kHz, and 11.33 kHz. Phase tracking of a particular station requires blanking of the receiver during all of the 10 second period except that segment which the selected station is transmitting. The OMEGA Gating Unit utilizes the phase-coherent 100 Hz signal available from the receiver as an input time base, and supplies a gating pulse to turn on the receiver during the selected segment. Front panel lamps indicate the sequence of OMEGA segments.

1-9. CAPABILITIES.

1-10. Specified capabilities of the OMEGA Gating Unit are as follows:

a. OMEGA Segment Generation. - Generates an exact eight segment OMEGA transmission format. Provides blanking of all segments of OMEGA transmissions except selected segment when used with modified 599J or K VLF/LF receivers.

b. Segment Selection. - The Model 543 OMEGA Gating Unit front panel, Figure 1-1, has a selector switch to select the desired OMEGA segment to be used for gating "On" of the VLF/LF receiver. An additional position of the switch permits normal VLF/LF receiver operation.

c. OMEGA Sychronization. - Synchronization of the start of the ten second OMEGA cycle can be accomplished with a MANUAL Start A pushbutton switch on the gating unit front panel, or with an external synchronization pulse. External synchronization is activated by means of a pushbutton ENABLE switch on the gating unit front panel, and uses a pulse between 3 and 10 volts with a rise time of less than 2 microseconds and a period of 10 to 10,000 microseconds. Segment synchronization can be advanced or retarded in 20 millisecond steps at the rate of one step per second by the ADV (advance) or RET (retard) pushbutton switches on the gating unit front panel.

d. Time Base Inputs. - Requires stable 100 Hz signal of 8 to 12 Vp-p connected to rear panel (marked 100 Hz INPUT CONNECTOR). This input is normally supplied from the receiver.

e. Segment Stability. - Timing stability of all segments is determined by the accuracy of the 100 Hz input source.

f. Segment Indicators. - Eight segment "On" indicator lamps are located on the gating unit front panel. The lamps indicate corresponding "On" time of each segment, A through H.

g. Alignment. - The OMEGA Gating Unit does not require periodic calibration. The unit is basically designed as a "Go - No Go" item.

SECTION II

PREPARATION FOR USE

2-1. RECEIVING INSPECTION.

2-2. Upon receipt the Model 543 OMEGA Gating Unit should be unpacked and given a thorough visual inspection. If any evidence of damage is noted the unit will be returned through supply channels for appropriate action. In case of a malfunctioning unit refer to the equipment warranty.

2-3. The Model 543 OMEGA Gating Unit is shipped fully assembled and ready for use. Installation consists of mounting the unit in the appropriate rack position and installing the interfacing cables between the gating unit and the receiver. Operating power requirements for the gating unit and the output from the gating unit to the receiver are provided by cable connection from the receiver's RECORD OUTPUT connector to the gating unit's OUTPUT CONNECTOR. The second cable provides the connection from the receiver's 100 Hz output to the gating unit's 100 Hz INPUT connector. To use the gating unit and an external chart recorder simultaneously, the connector at the receiver end of the output interconnect cable must be modified to all the required recorder connections.

2-4. RESHIPMENT.

2-5. If the Model 543 OMEGA Gating Unit is to be reshipped use the original packaging and container, if available and in satisfactory condition. If the original container is not available, packaging and packing will be in accordance with MIL-P-14232, Revision C, Interim Amendment 3.

SECTION III

OPERATING INSTRUCTIONS

3-0. INTRODUCTION.

3-1. This section contains operating instructions for the Model 543 OMEGA Gating Unit. The gating unit is used as an accessory to the Model 599J or K VLF/LF Receivers; refer to the appropriate manual for receiver operation.

3-2. Contained in this section is location and function of operating controls and indicators, gating unit synchronization and detailed theory of operation.

3-3. OPERATING CONTROLS AND INDICATORS.

3-4. Figure 3-1 shows the location of operating controls and indicators for the gating unit and includes a brief explanation of control and indicator functions. Explanations are keyed to the call-outs of the illustrated gating unit front panel.

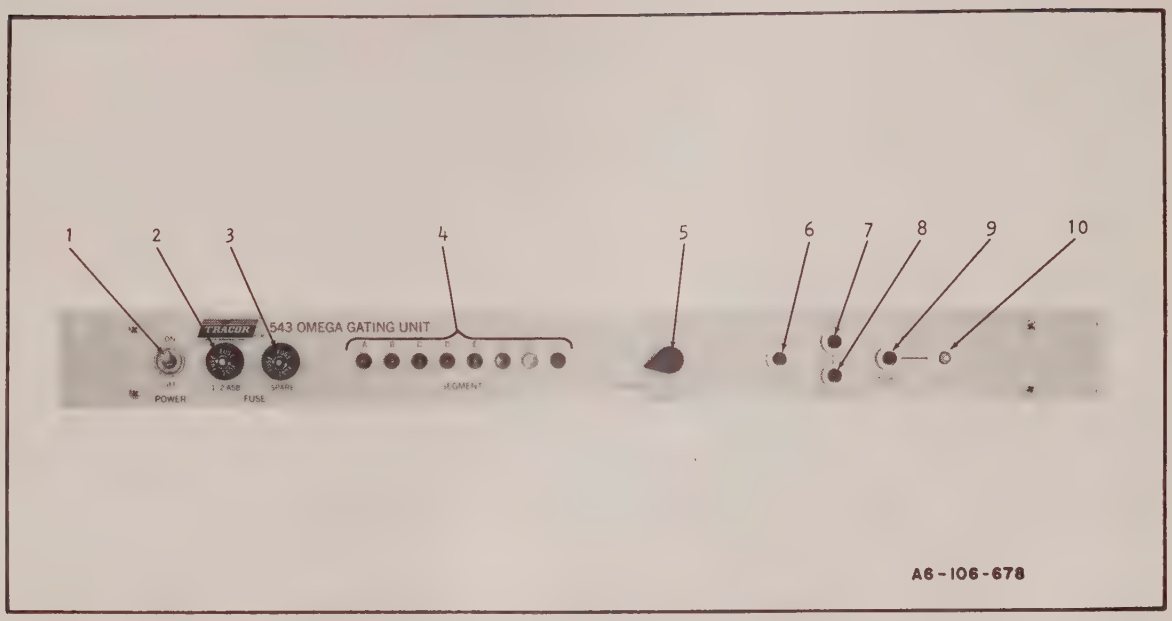
3-5. OPERATION.

3-6. To use the VLF Receiver/OMEGA Gating Unit combination to track an OMEGA station the following steps are required.

a. Turn the receiver power ON, the gating unit must receive its operating power from the receiver.

b. Turn gating unit POWER switch ON.

c. Tune the receiver to the desired OMEGA frequency.



Call Out	Name	Function
1	POWER	Two position ON-OFF toggle switch. Controls power to gating unit electronic circuits.
2	FUSE	½ Ampere fuse to protect gating unit electronic circuits and components.
3	FUSE	Spare
4	SEGMENT	Eight lamps, A thru H, provide a visual indication of "On" times of each corresponding segment, A thru H, during the 10 second OMEGA cycle.
5	MODE	Selector switch providing capability of selecting desired segment for gating of VLF receiver. Also permits normal operation of receiver.
6	MANUAL START A	Provides a manual means of synchronizing the start of the 10 second OMEGA cycle.
7	ADV (Advance)	When this switch is depressed, segment synchronization is advanced 20 msec each second.
8	RET (Retard)	When this switch is depressed, segment synchronization is retarded 20 msec each second.
9	ENABLE	Switch is depressed to enable outside source for synchronization of 10 second OMEGA cycle.
10	EX SYNC	Provides an input connector for external source of synchronization of 10 second OMEGA cycle.

Figure 3-1. OMEGA Gating Unit Controls and Functions

d. Synchronize the gating unit.

e. Set the gating unit MODE switch to the OMEGA segment of the selected station.

NOTE

To receive stations other than OMEGA, the gating unit MODE switch should be set to NORMAL position. In this mode the receiver operates continuously for normal VLF/LF reception.

3-7. OMEGA GATING UNIT SYNCHRONIZATION.

3-8. The gating unit generates the segment gates that permit the VLF/LF receiver to receive signals from OMEGA stations in the correct sequence. In order for this to occur, the segment gates must be synchronized to the transmission format of the OMEGA stations.

3-9. The gating unit may be synchronized from an external source or with the MANUAL Start A switch on the front panel of the gating unit.

3-10. EXTERNAL SYNCHRONIZATION.

3-11. To synchronize the gating unit from an external clock system, connect an accurate time pulse source to the receptacle on the gating unit front panel. Press and hold the enable switch on the gating unit to the synchronization pulse. The A-segment lamp should light to indicate that the sequence is starting with segment gate A when the external pulse occurs. External pulse rate must be 0.1 pps, or a submultiple.

3-12. Another method of synchronizing the gating unit from an external source is to use either a clock that is accurate within ± 0.1 seconds, or a WWV broadcast. If this method is used, the transition from segment gate H to A, as noted by the segment lamps should occur on the minute, and at 10 second intervals thereafter. Use the MANUAL synchronizing switch on the gating unit front panel to place the gating sequence at the start of segment A.

3-13. MANUAL SYNCHRONIZATION.

3-14. If an external synchronization pulse or an accurate (± 0.1 second) time source is not available, gating unit synchronization can be checked against the OMEGA signals if the operator can identify the stations being received. To synchronize the gating unit by this method proceed as follows:

a. Set the receiver for 13.6 kHz operation. This frequency is not as noisy as 10.2 kHz and is easier to monitor.

b. Plug a headset into the receiver PHONE jack and adjust the VOLUME control so the OMEGA stations can be heard. In most locations, two or three stations will be heard clearly.

c. Identify the clearest tone that is heard and note which time-segment (A through H) the tone occupies.

d. Observe the segment lamps and note which lamp is on when the tone occurs. Now count forward from this lamp to the lamp which is on during the A Segment.

EXAMPLE

Suppose from Step c, the clearest tone is occuring during Segment D (which would be Haiku, Hawaii, on 13.6 kHz, during Segment D). Suppose that when the Segment D tone is heard, the F lamp is on. The gating unit is ahead by two segments. Thus during Segment A the C lamp will be on.

This is easily seen as follows:

A is five segments after D, and C is five segments after F.

To bring the unit into synchronization, depress and release the Manual Start A pushbutton when the C lamp lights as described in e.

e. Depress the Manual Start A Button and release when the lamp corresponding to Segment A lights.

In the example, release when the C lamp lights.

f. When the tones and segments have been approximately synchronized, note whether the segment lamps light slightly before or after the tones are heard. Use the ADV and RET switches on the gating unit front panel to advance or retard the segment gates to perfect the synchronization. Each time the gating sequences change from one segment to the next while the ADV or RET switches are pressed, the cycle is advanced or retarded 0.02 second.

3-15. PRINCIPLES OF OPERATION.

3-16. All OMEGA stations transmit on a phase-locked, synchronized basis. Frequency is controlled by ultrastable atomic frequency standards at each station. Each station transmits at least three frequencies: 10.2 kHz, 13.6 kHz, and 11.3 kHz. The transmissions occur in sequence, at 10 second repetitive intervals as shown in figure 3-2. Each 10 second interval is divided into eight time segments, identified as segments A through H. A segment is a period of time during which a particular OMEGA station transmits a particular OMEGA frequency. For example, during segment B, Trinidad transmits at 10.2 kHz and Norway transmits at 13.6 kHz. A 0.2 second gap between segments prevents stations from overlapping their transmissions and eases synchronization requirements.

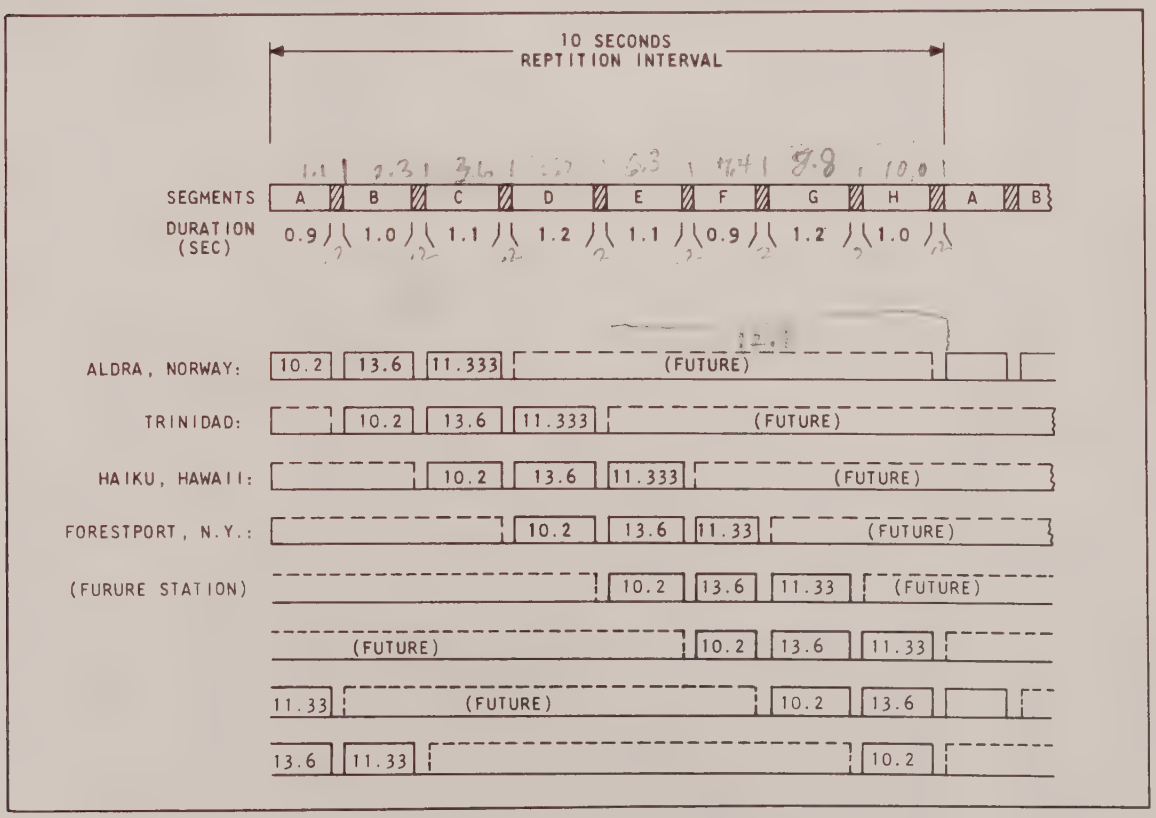


Figure 3-2. Format for OMEGA Transmissions

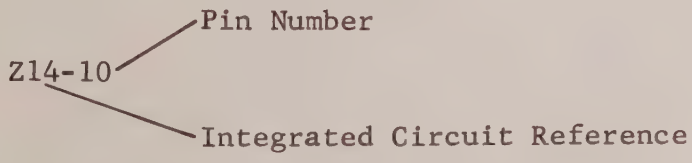
3-17. Phase tracking of an OMEGA signal requires gating the receiver "on" during a selected segment and then "off" during the remainder of the period. The gating sequence of the OMEGA Gating Unit matches the OMEGA format of figure 3-2, to turn the receiver "on" during the selected period.

3-18. A block diagram of the OMEGA Gating Unit is shown in figure 3-3. This figure shows that the 100 Hz phase-coherent output signal from the receiver is divided to a 10 Hz signal by a decade divider. This output is then fed to two additional decade counters and decimal decoders to provide a count by 100. The decoded counting sequence is 00 through 99. Decoded pulses are used to set, and reset, eight flip-flops which serve as the segment gate generators. The flip-flops drive the eight OMEGA segment lamp drivers and the segment selector switch on the front panel. The output from the segment selector switch drives a buffer that amplifier flanks the receiver.

3-19. A reset pulse may be applied to the eight segment flip-flops and the divide by 100 counter. The reset may be triggered manually or by a positive pulse of 3 to 10 volts, having a 2 microsecond minimum rise time. The reset pulse places the OMEGA Gating Unit sequence at the start of the A segment.

3-20. DETAILED THEORY OF OPERATION.

3-21. The following paragraphs discuss in detail the operation of the OMEGA Gating Unit. References will be made to integrated circuits as follows:



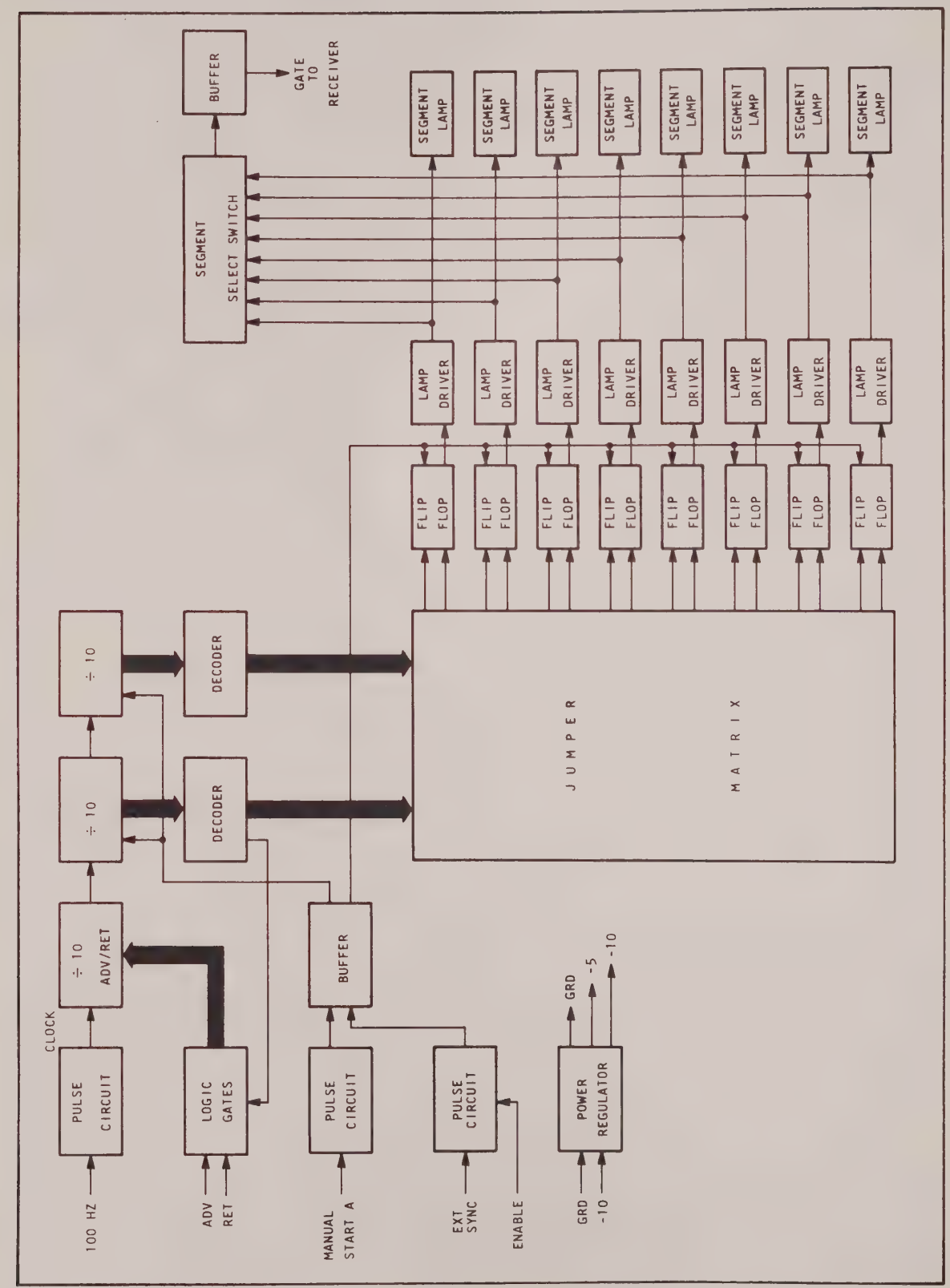


Figure 3-3. Block Diagram, OMEGA Gating Unit

3-22. 100 Hz Input. - The TRACOR 599J or K receivers provide a 100 Hz coherent input to the gating unit. The input is buffered through C1, R1, and Q1 to form a 100 Hz square wave with a rise time of less than 10μsec and a peak voltage of 5 V. The buffered signal is inverted by Q15. Output is checked at TP1.

3-23. Manual-External Synchronization. - Manual synchronization is accomplished by depressing front panel pushbutton switch S1 and releasing. Synchronization is initiated upon release of S1 by setting to zero the decade counters Z5 and Z7 and the flip-flops Z9, Z11, Z13, and Z15. The A segment lamp will light at initial synchronization. Synchronization is accomplished by momentarily dumping a current into Q2 through C2. The output is inverted by Z2-B. External synchronization is accomplished by connecting a +3 to +10 V pulse to the EXT-SYNC input on the front panel and then depressing the ENABLE switch S2. The ENABLE pushbutton switch grounds the emitter of Q3 and allows conduction of current through R4 with the next pulse.

3-24. Power Regulator. - The power regulator for the gating unit consists of Q4 and VR1 zener diode (3.6 V). The voltage across R10 is nominally 6.4 Vdc, and Q4 output is 5.7 Vdc. The circuitry is decoupled through R42 and C4.

3-25. Advance-Retard-Divide by Ten. - Advance, retard, and division by ten are all accomplished by Z4, Z3, Z2 and Z1. Z4 is reset to zero at the end of ten clock pulses for the normal divide by ten. Advance operation is accomplished by resetting at the end of eight counts, and retard is accomplished by inhibiting the reset operation and allowing division by twelve. Under normal operation, the wave form at TP2 is shown in figure 3-4B. Retard and advance operation are allowed only during the BCD zero state of the units counter, Z5, or when the output of the BCD to decimal decoder Z6, for "state 0" is logic zero. This point is

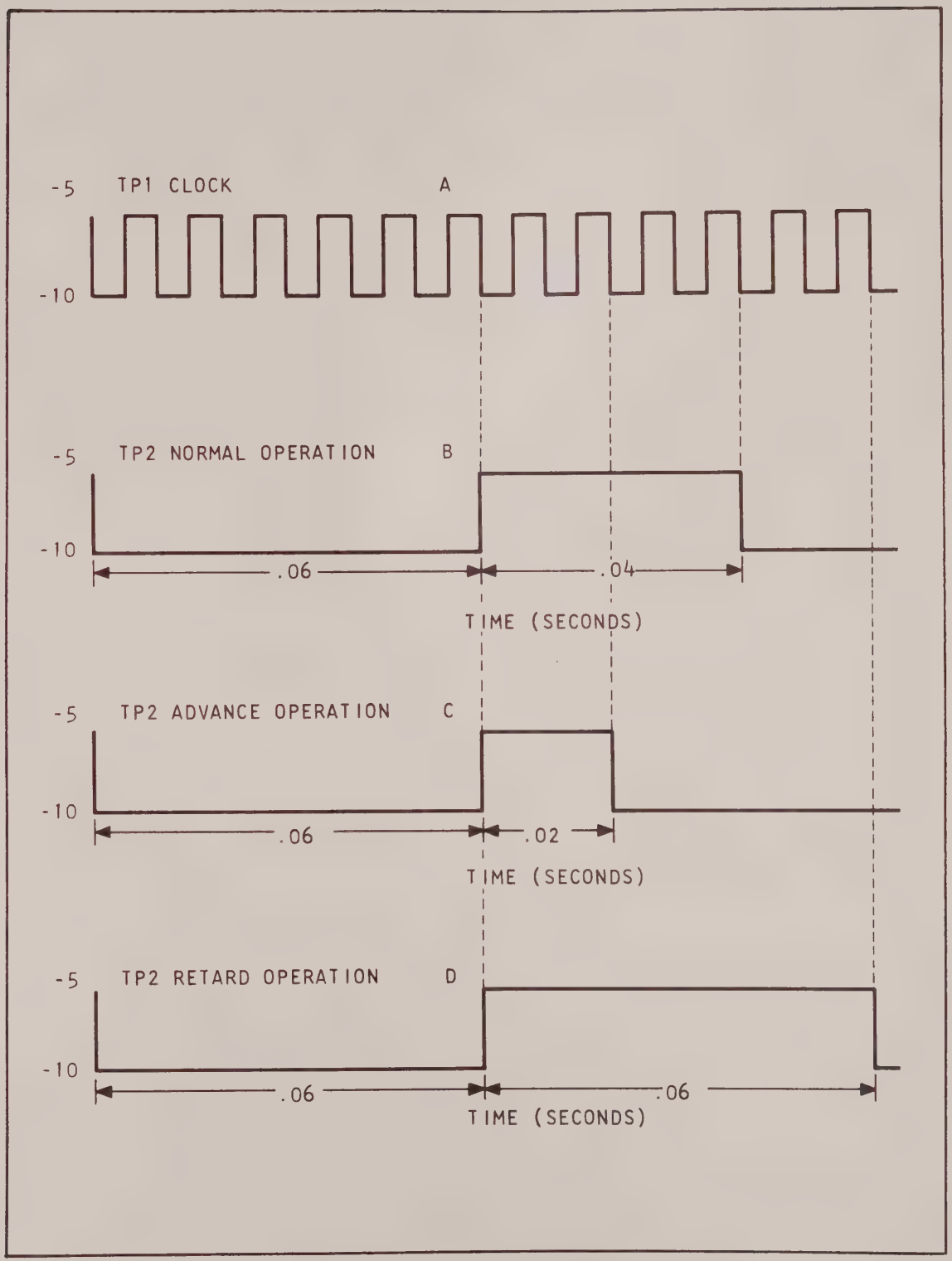


Figure 3-4. OMEGA Gating Unit Waveforms

marked TP5. TP2 wave forms are shown in figure 3-4C and D, with the scope triggered from the falling edge of TP5. Z1C and D provide a latch to insure the proper clearing of Z4.

3-26. Divide by 100. - Two decade counters, each driving a BCD to decimal decoder, provide units and tens count for all numbers between 00 and 99, during a 10 second interval. This precisely divides the interval into 100 parts, each 0.1 second long.

3-27. Segment Stop-Start. - Each segment generator consists of a J-K type flip-flop, two NOR gates, and a buffer. The J and K of each flip-flop are driven by a two input NOR gate, which in turn is connected to the units and tens buss lines. Selection of set and reset times for each segment flip-flop can be accomplished by jumpering the desired units and tens buss lines to the input of the stop and start NOR gates for each segment. Thus each segment can start or stop on any one of the 100 counts (00 through 99) within the 10 second interval in increments of 0.1 second per count.

EXAMPLE

If segment A is to start at time 0.0 seconds and end at 0.9 seconds, the jumpers would be connected between "0" units and "0" tens buss to the "A START NOR gate". To stop at 0.9 seconds, jumpers would be connected between the "9" units and "0" tens buss to the "A STOP NOR gate." These buss lines and jumper positions are easily identified on the PC board assembly.

3-28. Lamp Driver. - The lamp driver transistor is driven by a high state from the segment flip-flop. The lamp is between the collector of the driver transistor and ground on the gating unit.

3-29. Output Buffer. - Input to the OUTPUT buffer is through a nine position rotary switch. The switch is connected to the low side of the segment lamps. The NORMAL position is connected to a -10 from the receiver. The input is inverted by Q5 and drives Q6. R17 is a current limiting resistor.

SECTION IV

MAINTENANCE INSTRUCTIONS

4-0. INTRODUCTION.

4-1. The Model 543 OMEGA Gating Unit was designed without internal adjustment and components used were selected for long life and stability. If part replacement becomes necessary, only verification of operation is required.

4-2. REQUIRED TEST EQUIPMENT

4-3. Table 4-1 lists test equipment necessary for the trouble-shooting procedures described.

Table 4-1. Required Test Equipment

Name	Recommended Type
Oscilloscope	Tektronix Model 561A with dual trace plug-in, or equivalent.
Probe	2-10:1 attenuation, Tektronix Model P1000, or equivalent.
Counter	Hewlett-Packard Model 5233L or equivalent.

4-4. TROUBLESHOOTING

4-5. The purpose of this section is to facilitate the isolation of each trouble to a particular component or circuit in the OMEGA Gating Unit. Before attempting to troubleshoot the gating unit, the operation should become thoroughly familiar with the detailed theory of operation of Section III of this handbook.

4-6. To facilitate troubleshooting the Model 543 OMEGA Gating Unit a system schematic wiring diagram is presented in figure 4-1.

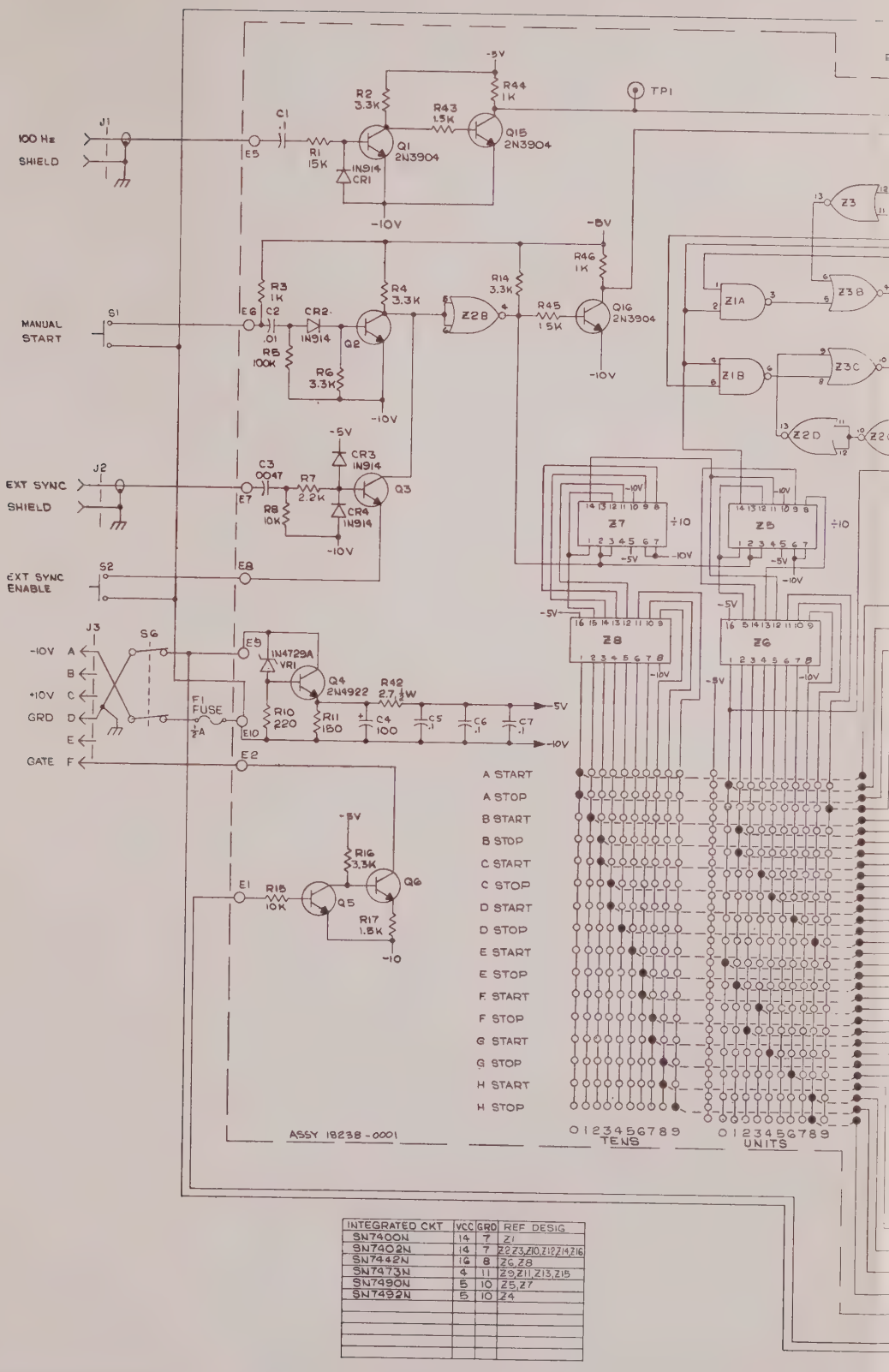
4-7. Before using the troubleshooting table, the gating unit must be connected to an operating 599 J or K receiver that has been modified for OMEGA operation and the gating unit POWER switch turned On.

Table 4-2 Gating Unit Troubleshooting Chart

Trouble	Probable Cause	Corrective Action
1. One SEGMENT lamp does not illuminate	a) Lamp defective b) Lamp driver transistor defective c) Segment flip-flop defective d) Jumper matrix circuit e) Decoder defective	a) Replace lamp b) Replace transistor c) Replace flip-flop d) Check jumper connections e) Replace decoder
2. ALL SEGMENT lamps do not illuminate	a) Line switch OFF b) Fuse open c) -10 Vdc line open d) No clock signal to segment flip-flops e) Decode counters defective f) 100 Hz buffer defective g) 100 Hz line not connected	a) Turn line switch ON b) Replace fuse c) Troubleshoot -10 Vdc line, repair as necessary d) Check input to V1. Replace Q1 or Q2. e) Replace counters f) Replace buffer g) Troubleshoot 100 Hz line, repair as necessary
3. Full blanking of receiver	a) Switch S5 defective b) Q5 or Q6 defective	a) Replace S5 b) Replace Q5 or Q6 as necessary
4. No blanking of receiver	a) Switch S5 defective b) Q5 or Q6 defective	a) Replace S5 b) Replace Q5 or Q6 as necessary

Table 4-2 Gating Unit Troubleshooting Chart (continued)

Trouble	Probable Cause	Corrective Action
5. Unable to MANUAL SYNC	a) Z2 defective b) Q2 defective c) Q2 related components d) MANUAL switch defective	a) Replace Z2 b) Replace Q2 c) Replace C2, CR2 etc. d) Replace S1
6. EX SYNC inoperative	a) Q3 defective b) Q3 related components c) ENABLE switch defective	a) Replace Q3 b) Replace C3, R7, CR3, CR4 c) Replace S
7. Unable to advance sequence	a) Z4, Z3, Z2 defective b) ADV switch defective	a) Replace Z4, Z3, Z2 as necessary b) Replace S
8. Unable to retard sequence	a) Z4, Z3, Z2 defective b) RET switch defective	a) Replace Z4, Z3, Z2 as necessary b) Replace S
9. Sequence running too fast or too slow	a) Z4, Z3, Z2 defective	a) Replace Z4, Z3, Z2 as necessary



INTEGRATED CKT	VCC	GRD	REF DESIG
SN7400N	14	7	Z1
SN7402N	14	7	Z2,Z3,Z10,Z12,Z14,Z16
SN7442N	16	8	Z6,Z8
SN7473N	4	11	Z9,Z11,Z13,Z15
SN7490N	5	10	Z5,Z7
SN7492N	5	10	Z4

1. UNLESS OTHERWISE SPECIFIED: ALL CAPACITORS ARE IN MICROFARADS; ALL RESISTORS ARE IN OHMS AND ARE 1/4W, 10%; ALL TRANSISTORS ARE MPS706

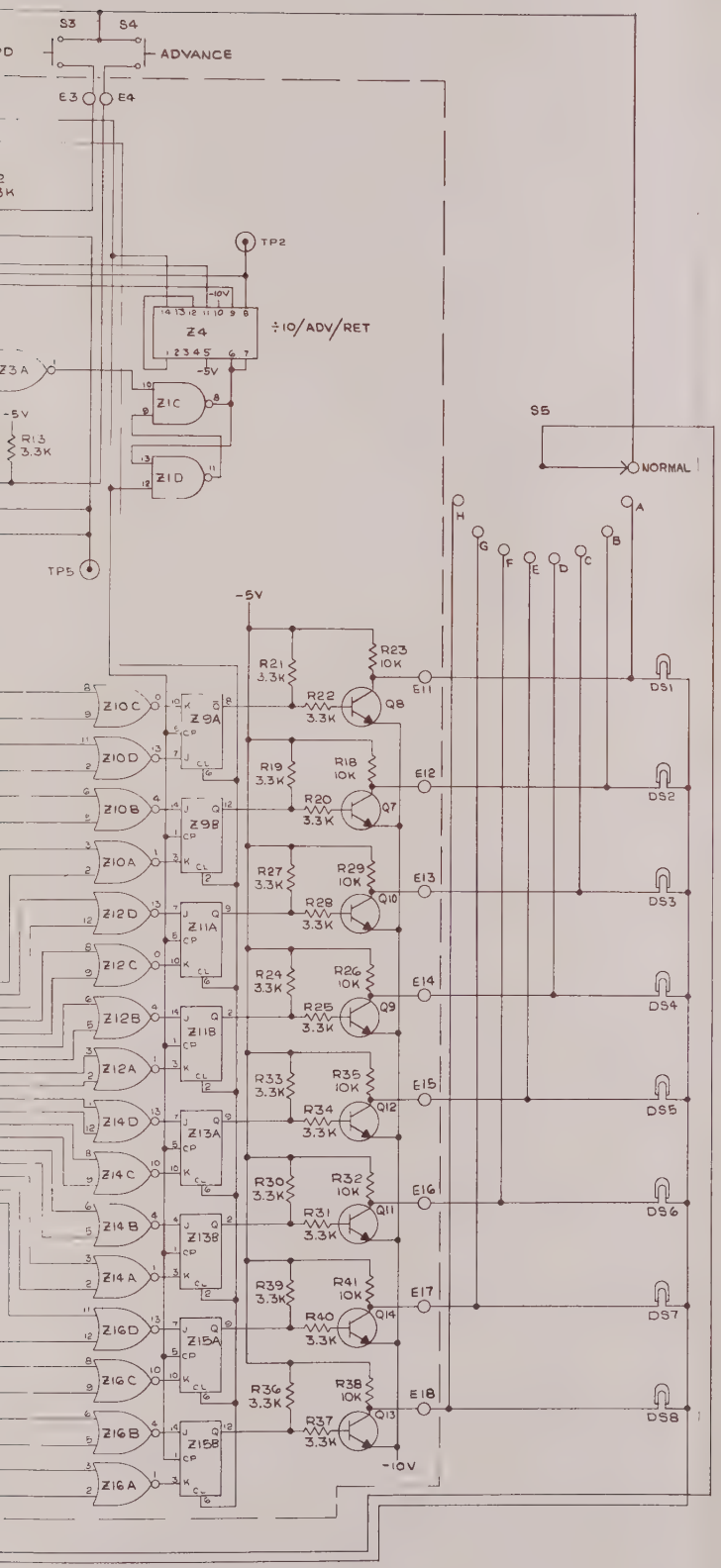


Figure 4-1. System Schematic, OMEGA Gating Unit

SECTION V

PART LIST

5-0. GENERAL.

5-1. For convenience in ordering replacement parts from local supply sources, the original manufacturer's code (Federal Supply Code for Manufacturer's Handbook H4-2) and part number are listed. Components that show no Vendor number meet MIL specs and can be purchased from several manufacturers.

5-2. REPLACEABLE PARTS.

5-3. To order a replacement part from TRACOR, Inc., address order to your authorized TRACOR, Inc. sales representative or to:

Customer Service
TRACOR, Inc.
6500 Tracor Lane
Austin, Texas 78721

Specify the following information for each part:

(a) Model and serial number for the instrument from the back panel.
(b) Assembly or sub-assembly, from the part itself or from the heading of the pertinent section of the list of replaceable parts.
(c) Circuit reference designator and full description of the part as shown on the list of replaceable parts.

5-4. To order a part not listed, add a complete description of its function and location.

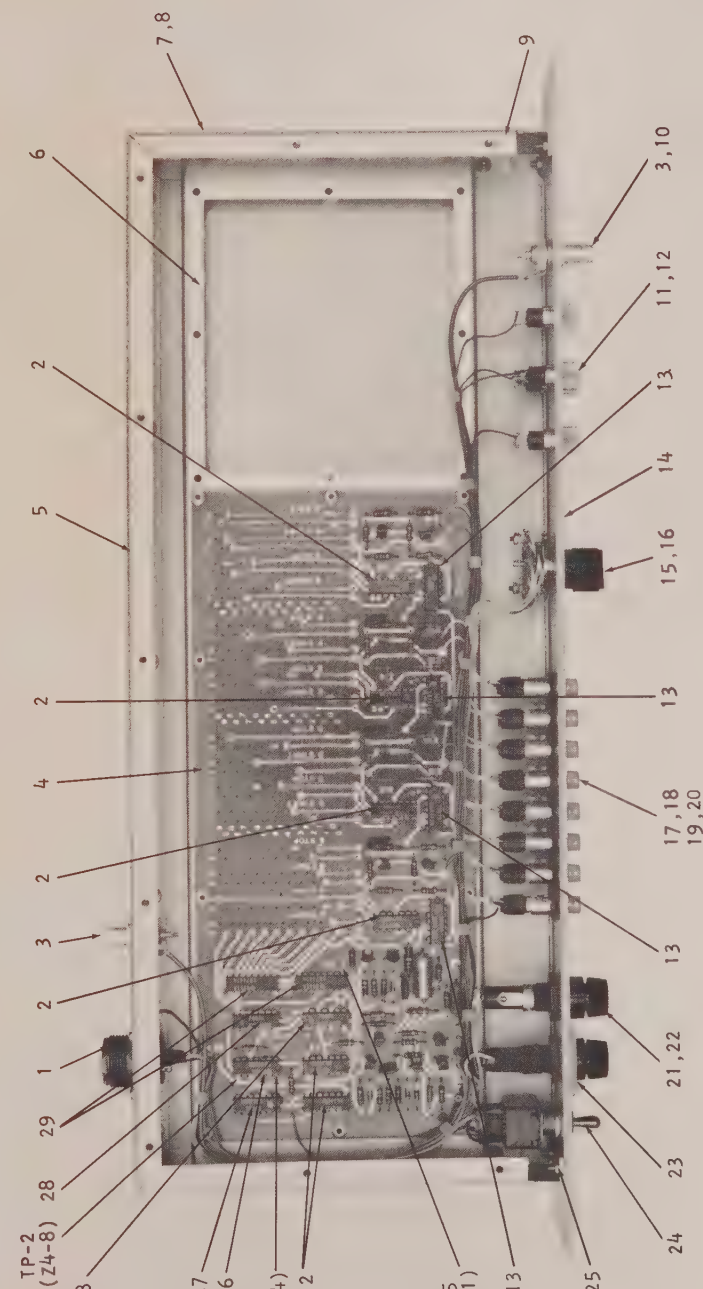


Figure 5-1. OMEGA Gating Unit (Sheet 1 of 2)

Table 5-1. Parts List

Figure & Index No.	Ref. Des.	TRACOR Stock No.	Description	Mfr. Code	Manufacturer's Part Number	Quantity
5-1		18237-0001	OMEGA GATING UNIT	19397	18237-0001	1
-1	J3	3819-0979	CONNECTOR	96906	MS3106R-145-6P	1
-2	Z2	23401-0001	INT CKT QUAD -2 INPUT	01295	SN7402N	1
-2	Z3	23401-0001	INT CKT QUAD -2 INPUT	01295	SN7402N	1
-2	Z10	23401-0001	INT CKT QUAD -2 INPUT	01295	SN7402N	1
-2	Z12	23401-0001	INT CKT QUAD -2 INPUT	01295	SN7402N	1
-2	Z14	23401-0001	INT CKT QUAD -2 INPUT	01295	SN7402N	1
-2	Z16	23401-0001	INT CKT QUAD -2 INPUT	01295	SN7402N	1
-3	J1	33747	CONNECTOR, BNC	02660	5575	1
-3	J2	33747	CONNECTOR, BNC	02660	5575	1
-4		18238-0001	PCB ASSY	19397	18238-0001	1
-5		9503-0004	SERIAL NUMBER TAG	19397	9503-0004	1
-6		18228-0001	TRAY, PCB	19397	18228-0001	1
-7		4419-0020	SCR BND HD X REC 4-40	73734	4-40 X 5/16 XREC ST STL	25
-8		620-0183	WASHER LOCK INT NO. 4	73734	99402	25
-9		18227-0001	CHASSIS	19397	18227-0001	1
-10		3624-0001	LUG SOLDER NO. 4	73734	38-100	1
-11	S1	3573-0001	SWITCH PUSHBUTTON	81073	30-1	1
-11	S2	3573-0001	SWITCH PUSHBUTTON	81073	30-1	1
-11	S3	3573-0001	SWITCH PUSHBUTTON	81073	30-1	1
-11	S4	3573-0001	SWITCH PUSHBUTTON	81073	30-1	1
-12		599871	NUT KNURLED	19397	599871	4
-13	Z9	23425-0001	INT CKT DUAL J-K	01295	SN7473N	1
-13	Z11	23425-0001	INT CKT DUAL J-K	01295	SN7473N	1
-13	Z13	23425-0001	INT CKT DUAL J-K	01295	SN7473N	1
-13	Z15	23425-0001	INT CKT DUAL J-K	01295	SN7473N	1
-14		18226-0002	FRONT PANEL	19397	18226-0002	1
-15	S5	3937-0011	SWITCH, ROTART	31356	X7109IN	1
-16		3458-0386	KNOB	96906	MS91528-0K1B	1
-17		3899-0002	SOCKEL, LAMP MTG	03797	2K	8
-18	DS1	3897-0009	LAMP, PLUG IN	03797	CF03-ACS-1869	1
-18	DS2	3897-0009	LAMP, PLUG IN	03797	CF03-ACS-1869	1
-18	DS3	3897-0009	LAMP, PLUG IN	03797	CF03-ACS-1869	1
-18	DS4	3897-0009	LAMP, PLUG IN	03797	CF03-ACS-1869	1
-18	DS5	3897-0009	LAMP, PLUG IN	03797	CF03-ACS-1869	1
-18	DS6	3897-0009	LAMP, PLUG IN	03797	CF03-ACS-1869	1
-18	DS7	3897-0009	LAMP, PLUG IN	03797	CF03-ACS-1869	1
-18	DS7	3897-0009	LAMP, PLUG IN	03797	CF03-ACS-1869	1
-19		3898-0001	CLIP, LAMP MTG	03797	10905-01 CAD PLATED	8
-20		3898-0005	RUBBER WASHER	03797	Q-145-008	8
-21		3769-0002	HOLDER, FUSE	75915	342014	2
-22	F1	3487-9502	FUSE 1/2A 250V	75915	FO 28 250V 1/2A	2
-23		9503-0004	PLATE IDENTIFICATION	19397	9503-0004	1
-24	S6	3490-0002	SWITCH, TOGGLE DPST	72653	34-182	1
-25		23562-0003	SCREW, OVAL 4-40 X 3/8	73734	21234	6
-26	Z4	23410-0001	INT CKT DIVIDE BY 12	01295	SN7492N	1
-27	Z1	23408-0001	INT CKT QUAD -2 INPUT	01295	SN7400N	1
-28	Z5	3938-0015	INT CKT	01295	SN7490N	1
-28	Z7	3938-0015	INT CKT	01295	SN7490N	1
-29	Z6	23757-0001	INT CKT	01295	SN7442N	1
-29	Z8	23757-0001	INT CKT	01295	SN7442N	1
-30	R2	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R4	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R6	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R9	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R12	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R13	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R14	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R16	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R19	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R20	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R21	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R22	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R24	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R25	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R27	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R28	200-0332	RES FXD COMP 3.30 K	81349	RC07GF332K	1
-30	R30	200-0332	RES FXD COMP 3.30 K	81340	RC07GF332K	1
-30	R31	200-0332	RES FXD COMP 3.30 K	81340	RC07GF332K	1
-30	R33	200-0332	RES FXD COMP 3.30 K	81340	RC07GF332K	1
-30	R34	200-0332	RES FXD COMP 3.30 K	81340	RC07GF332K	1
-30	R36	200-0332	RES FXD COMP 3.30 K	81340	RC07GF332K	1

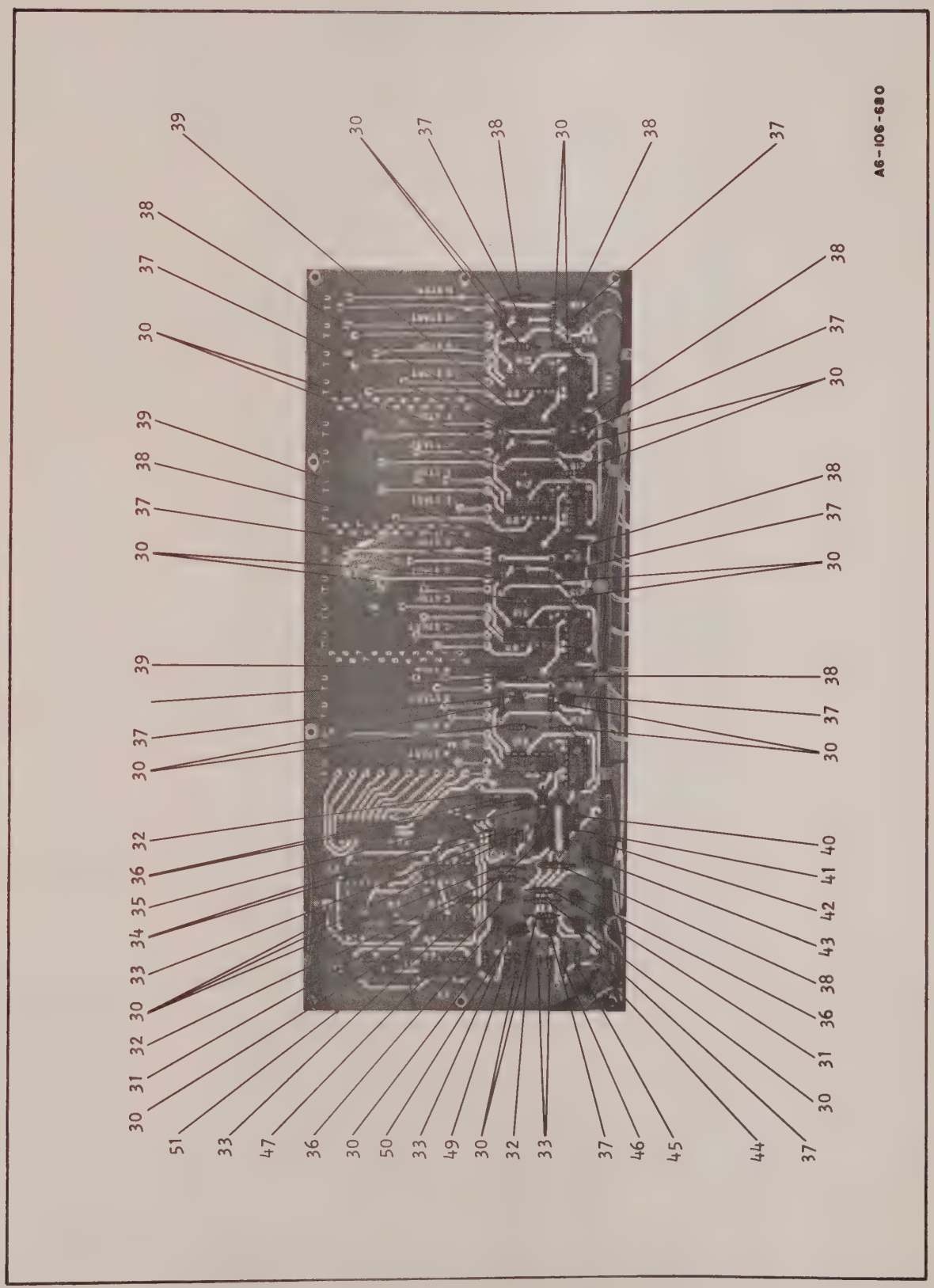


Figure 5-1. OMEGA Gating Unit (Sheet 2of 2)

Table 5-1. Parts List (Continued)

Figure & Index No.	Ref. Des.	TRACOR Stock No.	Description	Mfr. Code	Manufacturer's Part No.	Quantity
5-1-30	R37	200-0332	RES FXD COMP 3.30 K	81340	RC07GF332K	1
-30	R39	200-0332	RES FXD COMP 3.30 K	81340	RC07GF332K	1
-30	R40	200-0332	RES FXD COMP 3.30 K	81340	RC07GF332K	1
-31	R17	200-0152	RES FXD COMP 1.50 K	81349	RC07GF152K	1
-31	R45	200-0152	RES FXD COMP 1.50 K	81349	RC07GF152K	1
-32	R3	200-0102	RES FXD COMP 1.00 K	81349	RC07GF102K	1
-32	R44	200-0102	RES FXD COMP 1.00 K	81349	RC07GF102K	1
-32	R46	200-0102	RES FXD COMP 1.00 K	81349	RC07GF102K	1
-33	CR1	800-0914	DIODE IN 914	01295	IN914	1
-33	CR2	800-0914	DIODE IN 914	01295	IN914	1
-33	CR3	800-0914	DIODE IN 914	01295	IN914	1
-33		800-0914	DIODE IN 914	01295	IN914	1
-34	R1	200-0153	RES FXD COMP 15.0 K	81349	RC07GF153K	1
-34	R43	200-0153	RES FXD COMP 15.0 K	81349	RC07GF153K	1
-35	R42	208-9271	RES FXD COMP 15.0 K	81349	RC07GF153K	1
-36	Q1	900-3904	TSTR 2N3904	04713	2N3904	1
-36	Q15	900-3904	TSTR 2N3904	04713	2N3904	1
-36	Q16	900-3904	TSTR 2N3904	04713	2N3904	1
-37	Q2	3431-0043	TSTR	04713	MPS706	1
-37	Q3	3431-0043	TSTR	04713	MPS706	1
-37	Q5	3431-0043	TSTR	04713	MPS706	1
-37	Q6	3431-0043	TSTR	04713	MPS706	1
-37	Q7	3431-0043	TSTR	04713	MPS706	1
-37	Q8	3431-0043	TSTR	04713	MPS706	1
-37	Q9	3431-0043	TSTR	04713	MPS706	1
-37	Q10	3431-0043	TSTR	04713	MPS706	1
-37	Q11	3431-0043	TSTR	04713	MPS706	1
-37	Q12	3431-0043	TSTR	04713	MPS706	1
-37	Q13	3431-0043	TSTR	04713	MPS706	1
-37	Q14	3431-0043	TSTR	04713	MPS706	1
-38	R8	200-0103	RES FXD COMP 10.0 K	81349	RC07GF103K	1
-38	R15	200-0103	RES FXD COMP 10.0 K	81349	RC07GF103K	1
-38	R18	200-0103	RES FXD COMP 10.0 K	81349	RC07GF103K	1
-38	R23	200-0103	RES FXD COMP 10.0 K	81349	RC07GF103K	1
-38	R26	200-0103	RES FXD COMP 10.0 K	81349	RC07GF103K	1
-38	R29	200-0103	RES FXD COMP 10.0 K	81349	RC07GF103K	1
-38	R32	200-0103	RES FXD COMP 10.0 K	81349	RC07GF103K	1
-38	R35	200-0103	RES FXD COMP 10.0 K	81349	RC07GF103K	1
-38	R38	200-0103	RES FXD COMP 10.0 K	81349	RC07GF103K	1
-38	R41	200-0103	RES FXD COMP 10.0 K	81349	RC07GF103K	1
-39	C1	3321-9102	CAP FXD CER 0.1 MFD	71590	UK10-104	1
-39	C5	3321-9102	CAP FXD CER 0.1 MFD	71590	UK10-104	1
-39	C6	3321-9102	CAP FXD CER 0.1 MFD	71590	UK10-104	1
-39	C7	3321-9102	CAP FXD CER 0.1 MFD	71590	UK10-104	1
-40	R11	200-0151	RES FXD COMP 150 OHM	81349	RC07GF151K	1
-41	C4	8917-0101	CAP FXD TA 100 MFD	05397	CS13BC107K	1
-42	C3	3324-9474	CAP FXD MYL .0047 MFD	56289	192847292	1
-43	R7	200-0222	RES FXD COMP 2.20 K	81349	RC07GF222K	1
-44			SOLDER POINT			1
-45	R10	200-0221	RES FXD COMP 220. OHM	81349	RC07GF221K	1
-46	VR1	801-4729	DIODE IN4729A	01295	IN4729A	1
-47	Q4	900-4922	TRANSISTOR 2N4922	01295	2N4922	1
-48		649-0073	NUT	73734	70203 ST STC	1
-49	R5	200-0104	RES FXD COMP 100. K	81349	RC07GF104K	1
-50	C2	3403-9103	CAP FXD CER .01 UF	80183	TG-S10	1
-51		18234-0001	BOARD	19397	18234-0001	1
		18229-0001	COVER	19397	18229-0001	2
		18256-0001	ACCESSORY PART KIT	19397	18256-0001	1
		12113	MANUAL OPERATION	19397	12113	1

APPENDIX A

FERRITE LOOP ANTENNA WITH PREAMPLIFIER

A-1. INTRODUCTION.

A-2. This appendix provides a description, purpose, installation, general antenna operation, operating instructions, theory of operation, maintenance instructions, and parts list for the TRACOR Ferrite Loop Antenna with Preamplifier, Model 599-700R.

A-3. DESCRIPTION.

A-4. The Ferrite Loop Antenna System consists of a ferrite rod antenna with 50-foot cable and an active antenna coupler (preamplifier). The preamplifier is designed for mounting within the TRACOR Model 543 Gating Unit. The antenna utilizes an electrostatically shielded loop antenna wound around a large high permeability ferrite bar and is encapsulated in a weatherproof plastic housing. The antenna may be separated from the preamplifier by as much as 50 feet of cable. Leading particulars are shown in table A-1.

A-5. PURPOSE.

A-6. Where antenna compactness and high performance is essential, this option may be used as a direct replacement of large air-core loop antennas such as the TRACOR Model 599-603D. The antenna, when used in combination with the preamplifier, provides good sensitivity and frequency coverage over the 10kHz to 100kHz region.

Table A-1. Ferrite Loop Antenna System Leading Particulars

Item	Particulars
General	
Frequency Coverage	10 kHz-100 kHz
Equivalent Height	Greater than 0.001 meter at 20 kHz
Sensitivity	Atmospheric noise limited
Loop Antenna	
Type	Ferrite rod, single coil, electrostatically shielded, balanced output
Dimensions	Length: 13 ¼ in. Diameter: 2 ½ in. Height (overall): 5 in.
Weight	3 lb. (less cable)
Mounting	Standard 1 ½ in. male or female pipe fitting with indexing lock every 15°
Output cable	Shielded twinax (RG-108A/U) with UG-102/U twinax connector
Preamplifier	
Gain	Nominal 32 dB (at 20 kHz)
Input Connector	Twinax (UG-103/U)
Output Connector	Standard BNC; RG-58/U cable recommended for connection to receiver
Output Impedance	50 ohms nominal
Dynamic Range	Greater than 100 dB
Power Requirements	+ 10 Vdc at 1 ma
Mounting	Single printed circuit board, 5 in. x 4 ½ in., pre-drilled

A-7. INSTALLATION.

A-8. The antenna should be suitably mounted on rooftop, mast, atop a vehicle, or other exterior location. Avoid locations where the antenna is near high voltage power lines. The location should also be selected to avoid local noise sources such as power transformers and heavy electrical machinery. Changing the antenna location by a few feet can sometimes drastically reduce the effect of local noise sources. When mounting the antenna, use either the male or female pipe connector. Both are supplied, but only one should be utilized for mounting. After mounting the antenna, route the antenna cable to the OMEGA Gating Unit and connect it to the rear panel antenna input connector.

A-9. The preamplifier printed circuit board has been factory installed into the OMEGA Gating Unit with a standard BNC connection at the preamplifier output. Connect this output to the antenna input connector on the receiver.

A-10. GENERAL ANTENNA OPERATION.

A-11. A loop antenna responds to the magnetic-field (H-field) component of a transmitted radio signal. The induced voltage in the antenna is proportional to the rate-of-change of magnetic-field intensity of the electromagnetic signal.

A-12. A loop antenna has a figure-8 directivity pattern. See figure A-1. A plot of amplitude response as a function of relative bearing angle of the transmitter is shown in figure A-2. A loop antenna has a fairly sharp null in either direction along the antenna axis, and relatively broad lobes at right angles to the null axis. Note that the opposite lobes in the figure-8 pattern differ in electrical phase by 180°. Thus, if a loop antenna is gradually rotated, starting from an orientation

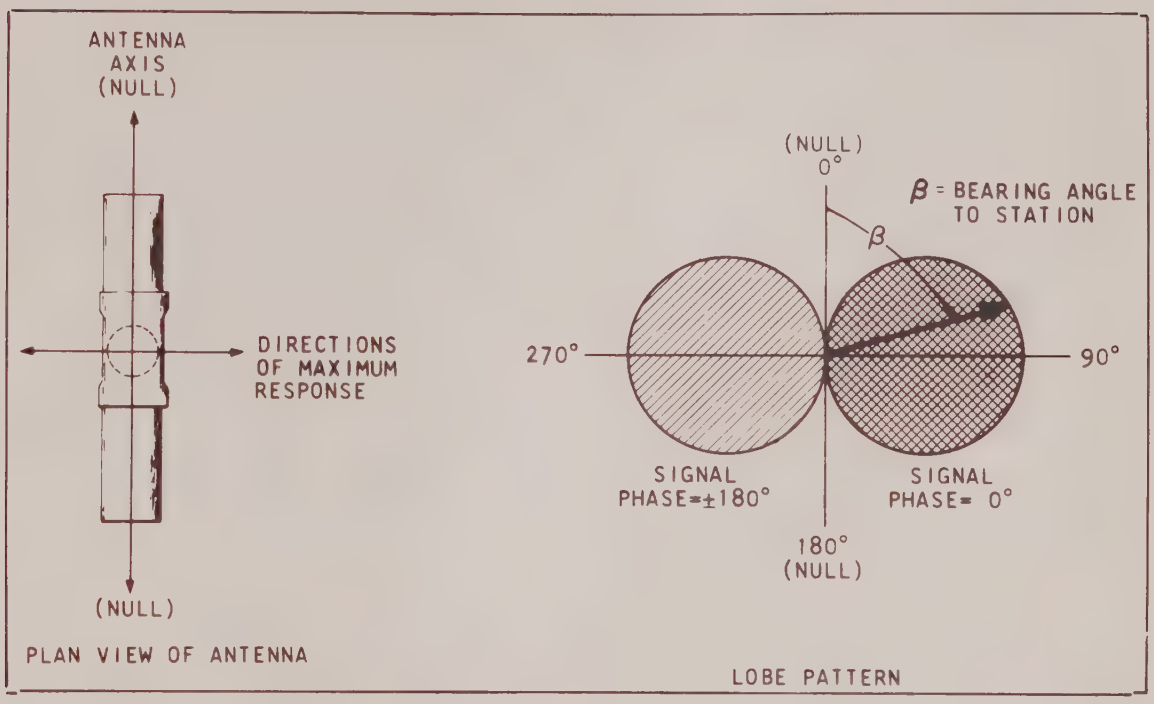


Figure A-1. Directivity of Loop Antenna

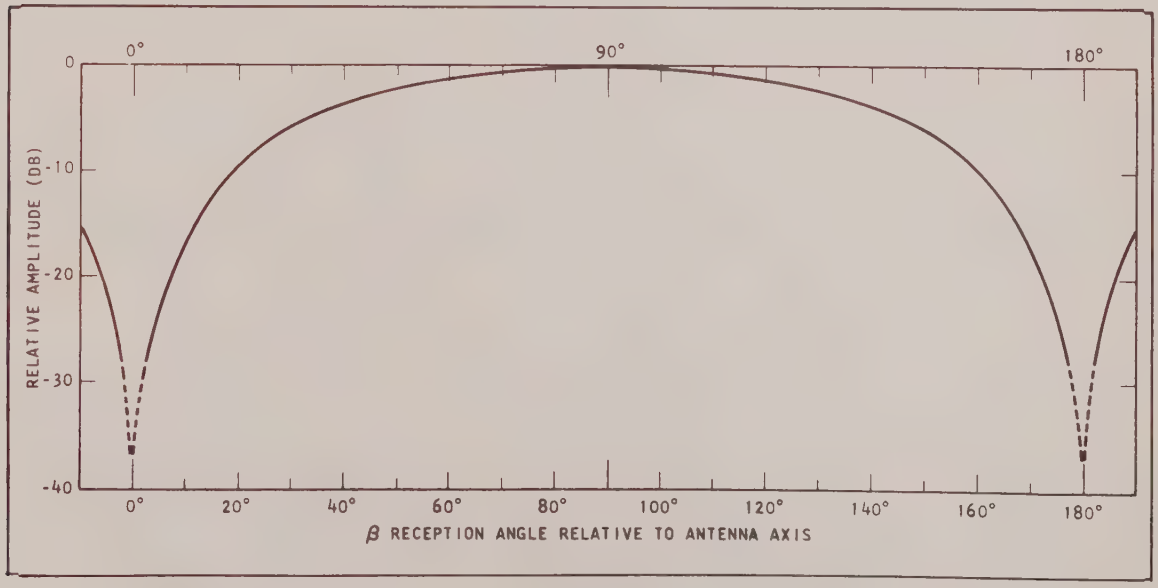


Figure A-2. Relative Response of Loop Antenna

angle(B=90°) in which maximum response is obtained, the amplitude will vary as shown in figure A-1. Negligible change in phase will be observed throughout each lobe; however, as the null region is crossed, the phase of the received signal will abruptly reverse ±180° from its previous constant value.

A-13. OPERATING INSTRUCTIONS.

A-14. This antenna and preamplifier are normally used in conjunction with a TRACOR OMEGA Gating Unit, Model 543, and a TRACOR Model 599J or 599K VLF/LF Receiver. Refer to the appropriate manuals for applicable operating instructions.

A-15. To determine that the antenna is functioning properly, check performance using a strong VLF communication station rather than an OMEGA signal. Assuming that the Receiver and Gating Unit are operating properly, verify that audible signals can be heard in the earphones.

A-16. Using the VLF Receiver, the sudden ±180° phase reversal as discussed in paragraph A-12 will be used to locate the bearing angle to a selected station and to determine the optimum orientation angle of the antenna for that station. The null direction is located by noting the angular position where the phase reversal occurs. Manually insert a 5 to 10 microsecond phase tracking error into the receiver. Rotate the antenna and observe the phase meter on the Receiver. The phase meter will reverse polarity as the antenna is rotated through a null. To obtain maximum antenna response, rotate the antenna ±90° from the null position. As illustrated in figure A-2, the ±90° is not critical.

A-17. After satisfactory operation on a strong station has been verified, tune the receiver to the desired station. Rotate the antenna to determine the null direction and rotate the antenna

$\pm 90^{\circ}$ for maximum response. The antenna is now ready for operation. A second method for positioning the antenna may be used if a compass is available and the relative bearing angle to this station is known within $\pm 15^{\circ}$. Rotate the antenna and use the compass to set the maximum point of the lobe pattern in the proper geographical direction.

A-18. Since the antenna has a figure-8 lobe pattern, and the lobes differ in phase by $\pm 180^{\circ}$, some convention should be adopted regarding the lobe that is normally employed. It is recommended that the antenna be installed with the side containing the nameplate, facing the desired station. To avoid phase reversal when removing the antenna connector, use the markers on the connector and receptacle to indicate polarity.

A-19. With the preamplifier installed, the higher gain of the input signal may require lowering the receiver gain control. Any continuous glow of the SFERICS indicator, without the random flashing normally associated with atmospheric noise impulses, indicates that the blanking control setting should be decreased.

A-20. If strong interference is present, the null characteristic of a loop antenna can be used to null out the interference. Unless the desired station and the interference source happen to lie along the same axis or bearing angle, it will be generally possible to orient the antenna so as to null out the interfering signal without incurring too great a loss of the desired signal. This interference or noise suppression technique will be fully effective only if the interference arrives from a single noise source covering a small, well-defined angular region.

A-21. THEORY OF OPERATION.

A-22. Ferrite Loop Antenna operation is discussed in paragraph A-12. This paragraph contains theory of operation for the preamplifier. Refer to the Preamplifier Schematic in figure A-3. The OMEGA signal feeds from the antenna to isolation transformer T1. Filter network C1, C2, and C3 pass frequencies in the 10kHz to 100kHz range. Isolation transformer T1 steps up the signal and feeds it to amplifier Q1. Amplifier Q1 direct couples the signal to Q2. Feedback is provided from Q2 emitter back to Q1 base. The gain is set by R8 and R2. Output isolation transformer T2 steps down the signal and feeds it to the preamplifier output connector. Filter network C8 through C13, R10, R11, and L1 filter out any transients on the 10-volt line.

A-23. MAINTENANCE INSTRUCTIONS.

A-24. The antenna and preamplifier was designed without need for internal adjustment. If part replacement becomes necessary, only verification of operation is required. Table A-2 lists test equipment necessary for troubleshooting the antenna and preamplifier.

Table A-2. Required Test Equipment

Name	Recommended Type
Audio Oscillator	Hewlett-Packard Model 200, or equivalent
Volt-ohmmeter (VOM)	Simpson Model 260, or equivalent
Oscilloscope	Tektronix Model 561, or equivalent

A-25. With the antenna disconnected from the preamplifier, approximately 2.5 ohms resistance should be measured across the

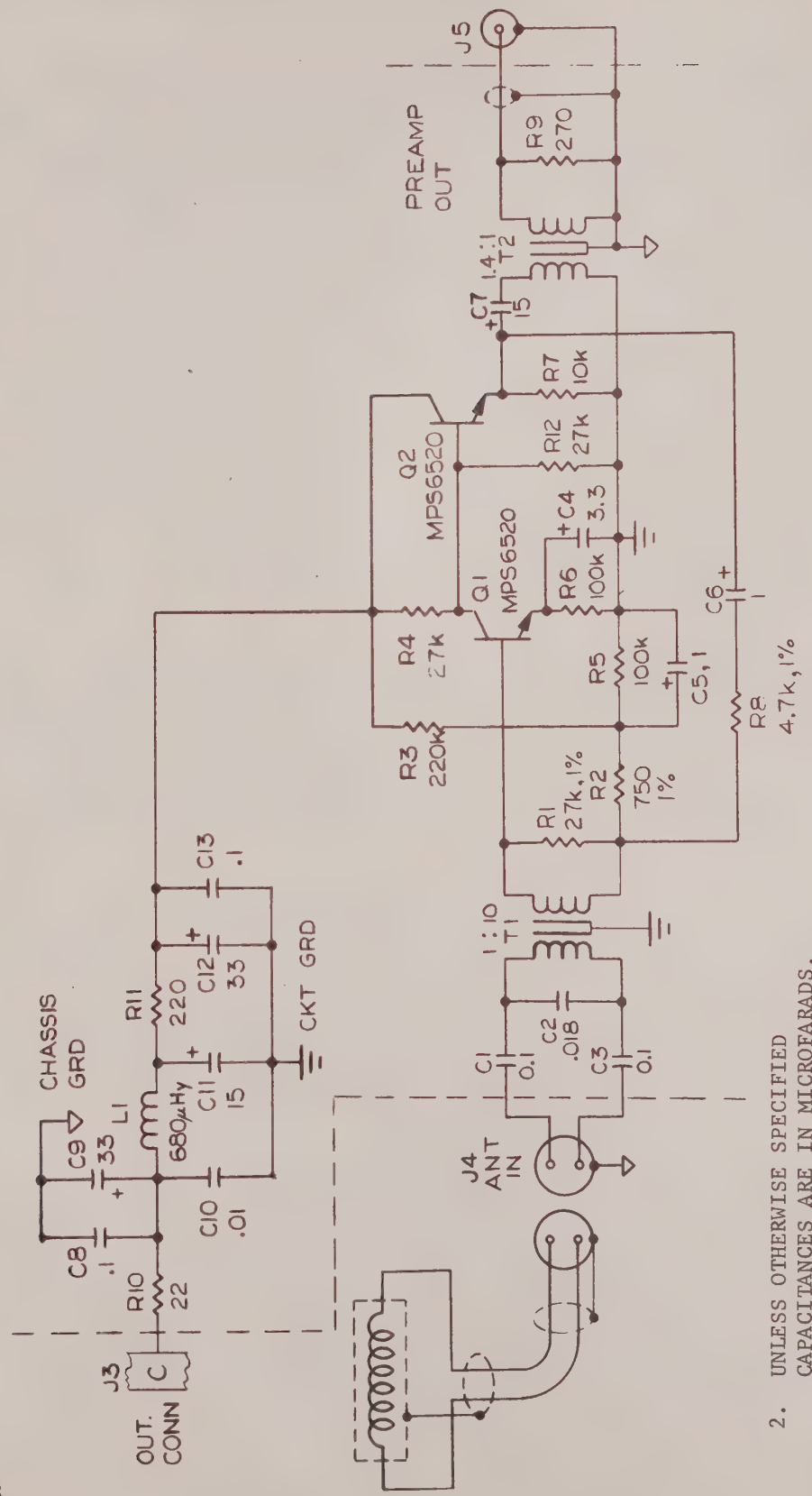


Figure A-3. Preamplifier Schematic Diagram

NOTES: 1. RESISTANCES ARE IN OHMS, 1/4 WATT. UNLESS OTHERWISE SPECIFIED
2. CAPACITANCES ARE IN MICROFARADS. UNLESS OTHERWISE SPECIFIED

antenna cable connector. The resistance between the cable shield and either connector pin should be infinite. An inductance test may also be performed. A measured inductance of 2.75±0.2 millihenrys across the antenna is normal.

A-26. If the antenna readings are normal, the preamplifier may be at fault. Apply a 3±2 mv, 10.2kHz signal to the antenna input connector on the preamplifier. Using the oscilloscope, standard signal tracing procedures should be used to trace the signal through the preamplifier.

A-27. REPLACEABLE PARTS.

A-28. Table A-3 provides a list of replaceable parts for the preamplifier. Information concerning the use of the table is found in Section V of this manual. Refer to figure A-4 for the location of a replaceable part on the preamplifier board.

Table A-3. Parts List

Figure & Index No.	Ref. Des.	TRACOR Stock No.	Description	Mfr. Code	Manufacturer s Part Number	Quantity
A-4		18536-0001	PREAMPLIFIER ASSY.	19397	18536-0001	1
-1		18484-0001	PC Board	19397	18484-0001	1
-2	C10	3403-9103	CAP FXD CER .01 MFD	80183	TG-S10	1
-3	C8	3321-9102	CAP FXD CER .1 MFD	71590	UK10-104	1
-3	C13	3321-9102	CAP FXD CER .1 MFD	71590	UK10-104	1
-4	C2	3324-9183	CAP FXD MYL .018 MFD	56289	192P18392	1
-5	C1	3324-9102	CAP FXD MYL .1 MFD	56289	192P10492	1
-5	C3	3324-9102	CAP FXD MYL .1 MFD	56289	192P10492	1
-6	C5	21485-9101	CAP FXD TA 1 MFD	05397	CS13BF105K	1
-6	C6	21485-9101	CAP FXD TA 1 MFD	05397	CS13BF105K	1
-7	C4	8916-9331	CAP FXD TA 3.3 MFD	05397	CS13BD335K	1
-8	C7	8914-0150	CAP FXD TA 15 MFD	01295	CS13BE156K	1
-8	C11	8914-0150	CAP FXD TA 15 MFD	01295	CS13BE156K	1
-9	C9	8914-0330	CAP FXD TA 33 MFD	01295	CS13BE336K	1
-9	C12	8914-0330	CAP FXD TA 33 MFD	01295	CS13BE336K	1
-10	L1	3422-0681	INDUCTOR 680 MHY	99800	2500-20	1
-11	R7	200-0103	RES FXD COMP 10 K	01121	RC07GF103K	1
-12	R5	200-0104	RES FXD COMP 100 K	01121	RC07GF104K	1
-12	R6	200-0104	RES FXD COMP 100 K	01121	RC07GF104K	1
-13	R10	200-0220	RES FXD COMP 22 OHM	01121	RC07GF220K	1
-14	R11	200-0221	RES FXD COMP 220 OHM	01121	RC07GF221K	1
-15	R3	200-0224	RES FXD COMP 220 K	01121	RC07GF224K	1
-16	R9	200-0271	RES FXD COMP 270 OHM	01121	RC07GF271K	1
-17	R4	200-0273	RES FXD COMP 27 K	01121	RC07GF273K	1
-17	R12	200-0273	RES FXD COMP 27 K	01121	RC07GF273K	1
-18	R2	23984	RES FXD FILM 750 OHM	07115	C4 STYLE	1
-19	R8	23984	RES FXD FILM 4.7 K	07115	C4 STYLE	1
-20	R1	23984	RES FXD FILM 27 K	07115	C4 STYLE	1
-21	T1	18541	TRANSFORMER ASSY.	19397	18541	1
-22	T2	18542	TRANSFORMER ASSY.	19397	18542	1
-23	Q1	3431-0044	TSTR	04713	MPS 6520	1
-23	Q2	3431-0044	TSTR	04713	MPS 6520	1
N/A	N/A	18530-0001	ANTENNA ELEMENT AND CABLE ASSY	19397	18530-0001	1
			4931-00-007-(185) 1180 8140-00-157-0442		28510S, ALEVA	
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N/A	J5	3391-0001	CONN BNC MALE	02660	UG-657/U	

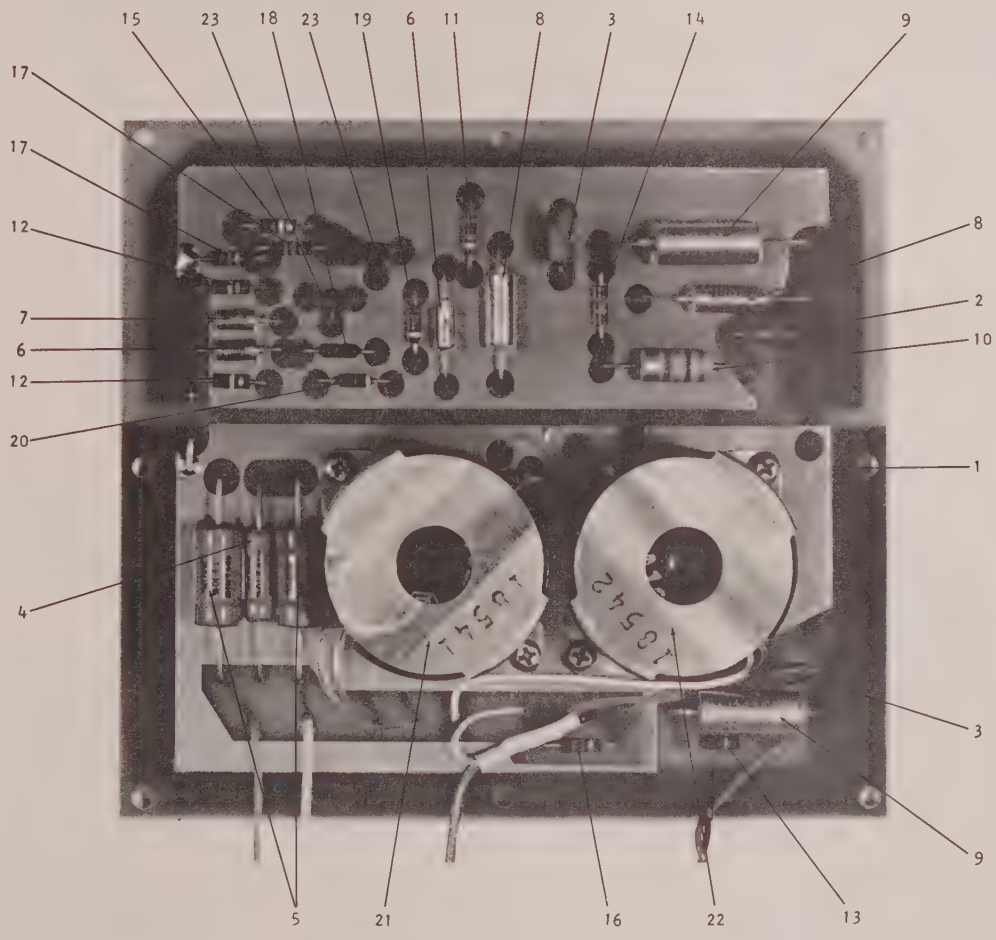

Figure A-4. Preamplifier PC Board

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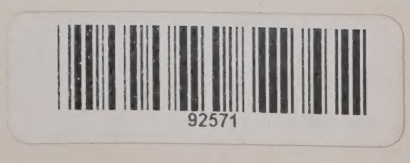
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